Small Business Innovation Research/Small Business Tech Transfer

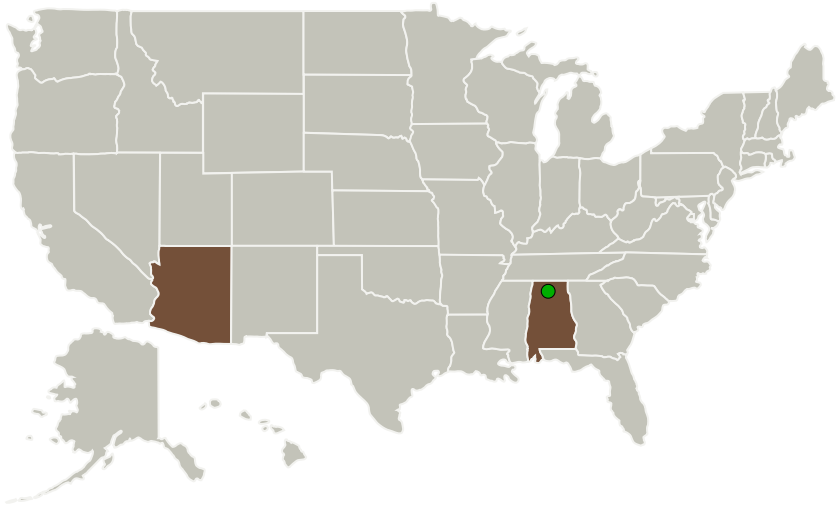
Fault Management: Degradation Signature Detection, Modeling, and Processing, Phase I

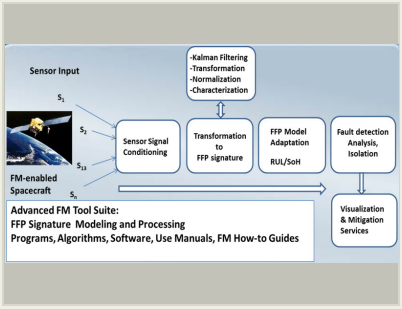
Completed Technology Project (2013 - 2013)

Project Introduction

Fault to Failure Progression (FFP) signature modeling and processing is a new method for applying condition-based signal data to detect degradation, to identify fault modes, and to produce system estimates for State of Health (SoH) and Remaining Useful Life (RUL). The base technology has been applied for prognostic purposes for various government-sponsored programs, but FFP signature modeling and processing has not been applied for the area of Fault Management, nor does it include such features as fault dictionaries, lookup tables, and management algorithms. The technology includes Ridgetop-designed and developed algorithms to do the following: (1) perform Kalman Filtering to reduce noise; (2) transform sensor signal data to reveal underlying (hidden) FFP signatures; (3) normalize units-of-measure dependent signal data into dimensionless FFP signatures to facilitate re-use and reduce the time to characterize and define new FFP signatures; (4) define and use model definitions that reduce memory requirements and support fast and accurate processing and calculations; (5) two forms of trajectory curve characterization, both straight-line and curvilinear; (6) a fast yet accurate, graphics-based mathematical routine to adapt an FFP model to received data; (7) amplitude and time updates similar to Extended Kalman Filtering to estimate how long it will take an adapted FFP model to reach a defined failure threshold; and (8) produce SoH and RUL estimates that rapidly converge to the estimated time-to-failure (TTF) solution. The FFP signature modeling and processing will include additional innovation to support FM to minimize application-specific programming, those include algorithms to simplify fault identification and isolation.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Ridgetop Group, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Tucson, Arizona
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Arizona

Project Transitions

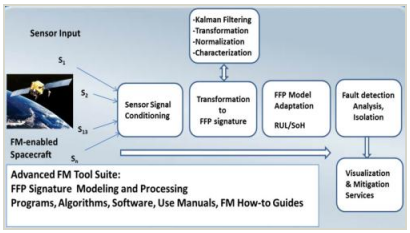
May 2013: Project Start

November 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138157)*

Images



Project Image
Fault Management: Degradation Signature Detection, Modeling, and Processing
(https://techport.nasa.gov/image/128003)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Ridgetop Group, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

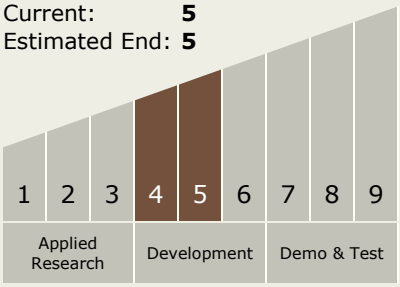
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
James Hofmeister

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



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Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.2 Navigation Technologies
    - TX17.2.3 Navigation Sensors

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System